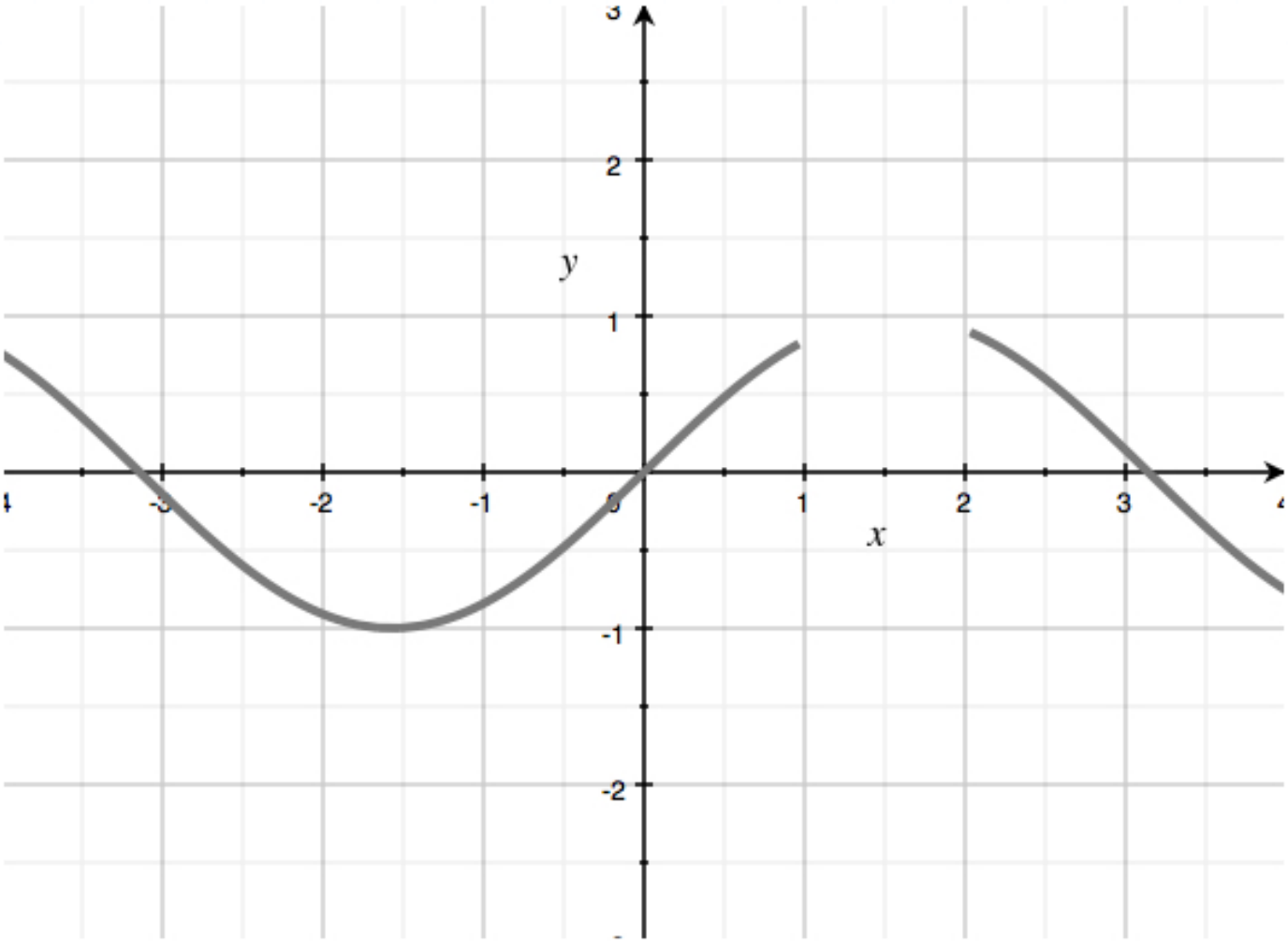
Horizontal and vertical tangent lines and differentiability

Before we jump into finding derivatives with the shortcuts, let's talk about instances when the derivative doesn't exist. When the derivative doesn't exist at a point in the graph, we say that the original function is not differentiable there.

Discontinuities

A derivative cannot exist at a point of discontinuity in a function. This does not mean that the function is not differentiable at other points in its domain, only that the function is not differentiable at the specific point of discontinuity.



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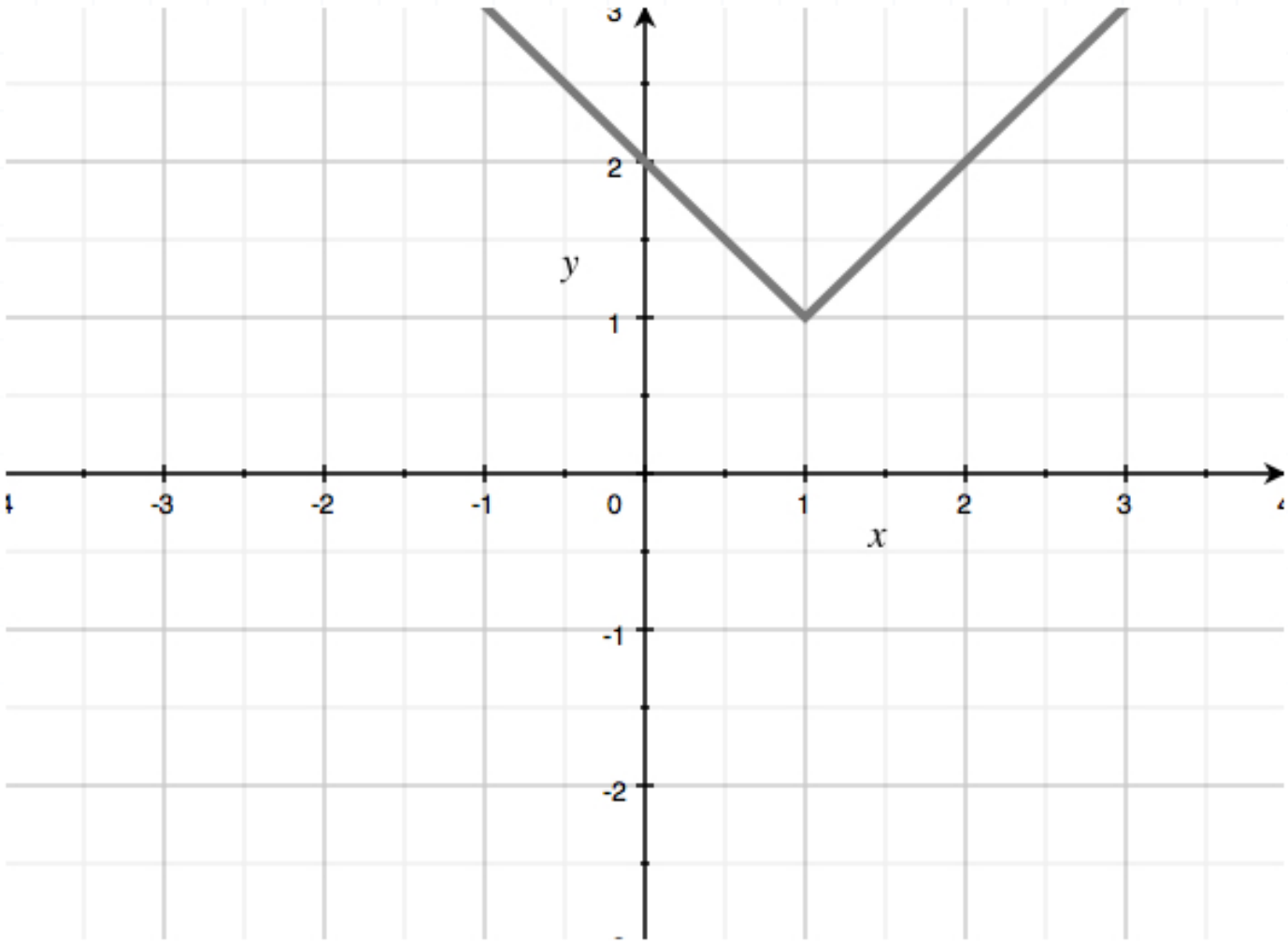
Sharp points

If a graph contains a sharp point (called a cusp), the function is not differentiable at that point. You're most likely to find sharp points in your function if it contains absolute values or if it's a piecewise-defined function.



Vertical tangent lines

Since the slope of a vertical line is undefined, and a tangent line represents the slope of the graph, a tangent line by definition cannot be vertical, so the derivative cannot be a perfectly vertical line.

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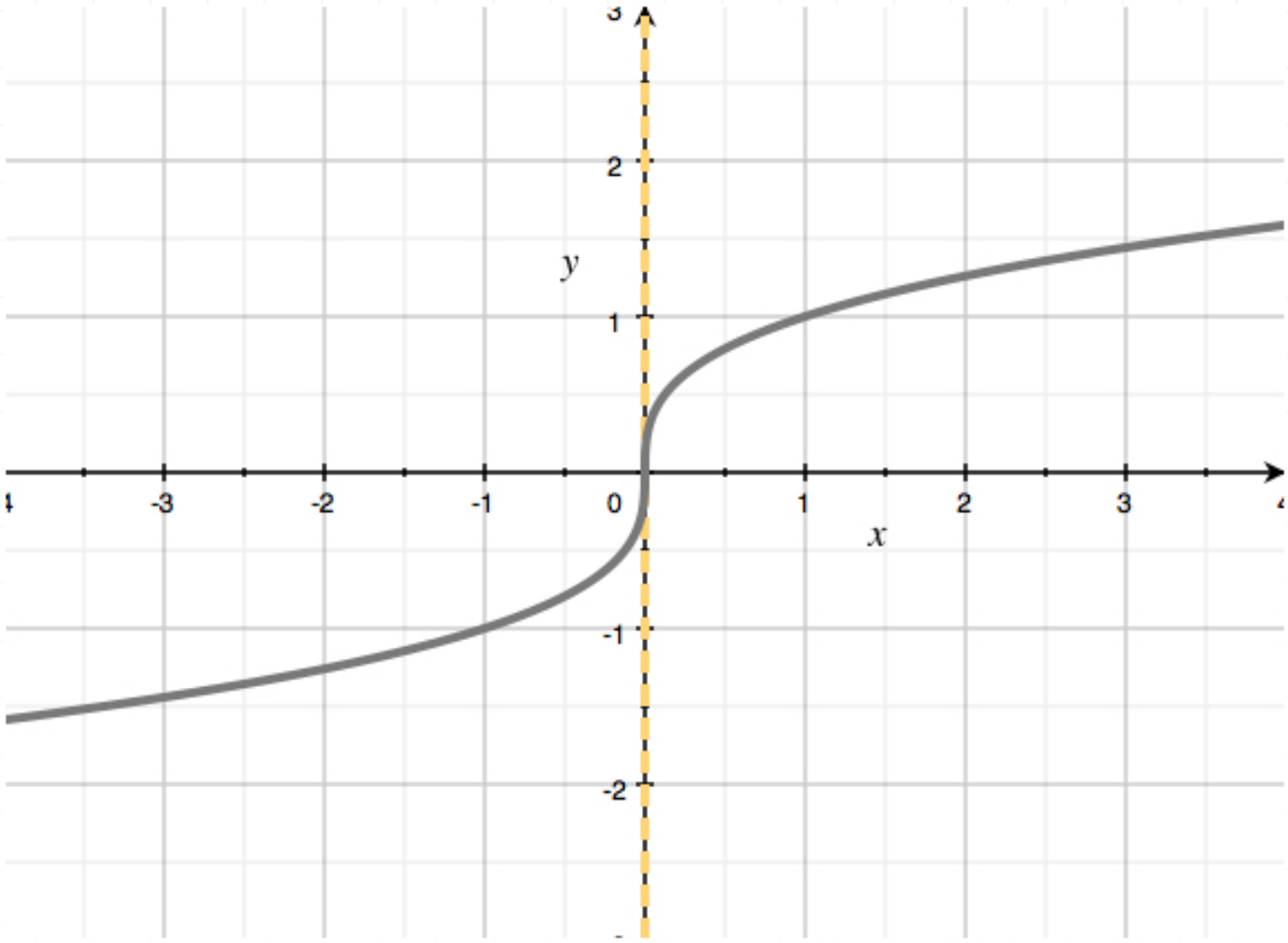

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